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INSTRUMENT ROOM COPY

Rutherford ELECTRONICS CO.

# INSTRUCTION MANUAL

## MODEL B15

INSTRUMENT ROOM COPY

## MODEL B15R

# SPECIFICATIONS

The following are the specifications of the model B15 and/or B15R.

MAIN PULSE

REPETITION RATE - 5 cycles/sec. to 5mc/sec.

By internal oscillator, continously variable in six overlapping decade ranges.

From an external source by the trigger specified below.

Single shot by built-in front panel push button.

PULSE DELAY - 0 to 10,000 µsec.

Continuously variable in five overlapping decade ranges as measured from the sync pulse specified below.

In the pulse pair mode, the first pulse is fixed at approximately zero delay and the second pulse is delayable with respect to the leading edge of the first. Spacing between the trailing edge of the first pulse and the leading edge of the second pulse may be set to any value from the pulse width being used to 10,000 µsec.

Maximum delay duty factor, is 70% of pulse to pulse spacing at repetition rates of 1 mc/-sec., or less. This figure decreases to 20% at 5 mc/sec.

PULSE WIDTH - 0.06 to 10,000 microseconds

Continuously variable in five overlapping decade ranges, as measured at the 50% amplitude points.

In the pulse pair mode, both pulses are controlled simultaneously in width.

Maximum width duty factor is 30% of pulse to pulse spacing at full output amplitude. Maximum pulse width duty factor, at reduced amplitude, is 70% at repetition rates of 2 mc/sec., or less. This figure decreases to 40% at 5 mc/sec.

Front panel indicator warns of reduced amplitude condition at duty factors in excess of 30%.

In the pulse pair mode, the duty factor limitations apply to the sum of both pulse widths.

AMPLITUDE - 0 to 10 volts, peak, into 50 Ω

Continuously variable by front panel control and 20 db fixed attenuator.

Full output amplitude is 16 volts into 1,000 Ω or more and 4 volts into 10 Ω.

Reduced amplitudes at width duty factors in excess of 30% are approximately 7.5 volts into 50 Ω at 2 mc/sec. and 70% duty factor and 9 volts into 50 Ω at 5 mc/sec. and 40% duty factor.

Slight reduction of output amplitude occurs at extremely low line voltage. Output amplitude is approximately 9.75 volts into 50 Ω with 105 volt line input.

Output is with respect to chassis ground. The output exhibits no measurable DC component.

In the pulse pair mode, the amplitude of both pulses is controlled simultaneously.

RISE TIME - 10 nanoseconds, or less.

FALL TIME - 10 nanoseconds, or less.

POLARITY - Positive or negative, but not simultaneously.

In the pulse pair mode, both pulses are of the same polarity.

OVERSHOOT - 5% maximum, at full amplitude.

UNDERSHOOT - 5%, maximum, at full amplitude.

DROOP - Negligible at widths of 1,000 µsec. or less. 10%, maximum, at 10,000 µsec.

## SYNC PULSE

The following sync pulse is available as a $T_o$ timing pulse.

DELAY - Approximately 120 nanoseconds with respect to an external trigger.

WIDTH - 75 nanoseconds, minimum.

AMPLITUDE - 5 volts, peak, minimum, open circuit.

RISE TIME - 25 nanoseconds, maximum.

POLARITY - Positive.

## EXTERNAL TRIGGER

The unit may be triggered by a pulse which exhibits the following characteristics.

REPETITION RATE - 5 mc/sec., or less.

AMPLITUDE - 2 to 10 volts, peak.

RISE TIME - 1 usec, or less.

POLARITY - Positive.

NOTE: Several Model B15s may be triggered simultaneously from the sync pulse out of a master B15. Thus, the use of several B15s provides multiple output pulses which are synchronized in repetition rate and independent of each other in all other parameters.

## MISCELLANEOUS SPECIFICATIONS

### PHYSICAL DIMENSIONS

Cabinet Model, B15 - 12" wide, 5" high, 11 1/2 deep.

Rack Mounted, B15R - 19" wide, 5 1/4" high 11 1/2" deep.

### WEIGHT

With battery pack - 14 lbs, net - 19 lbs, shipping.

Without battery pack - 10 lbs, net - 15 lbs, shipping.

Battery pack only - 4 lbs, net - 5 lbs, shipping.

### POWER REQUIRED

105 to 125 volts, AC, 50 to 400 cps, 20 watts, maximum.

Wired for 220 volt operation on request, no additional charge.

### BATTERY PACK - PART 9001001 (OPTIONAL)

Model B15 may be powered from a self-contained rechargeable battery pack. Battery charger is built into all units. Unit will operate for approximately eight (8) hours at 30% duty factor on a fully charged battery pack.

### INPUT - OUTPUT CONNECTORS

Power in - Standard 3 wire power cord.
Signal connectors - type BNC.

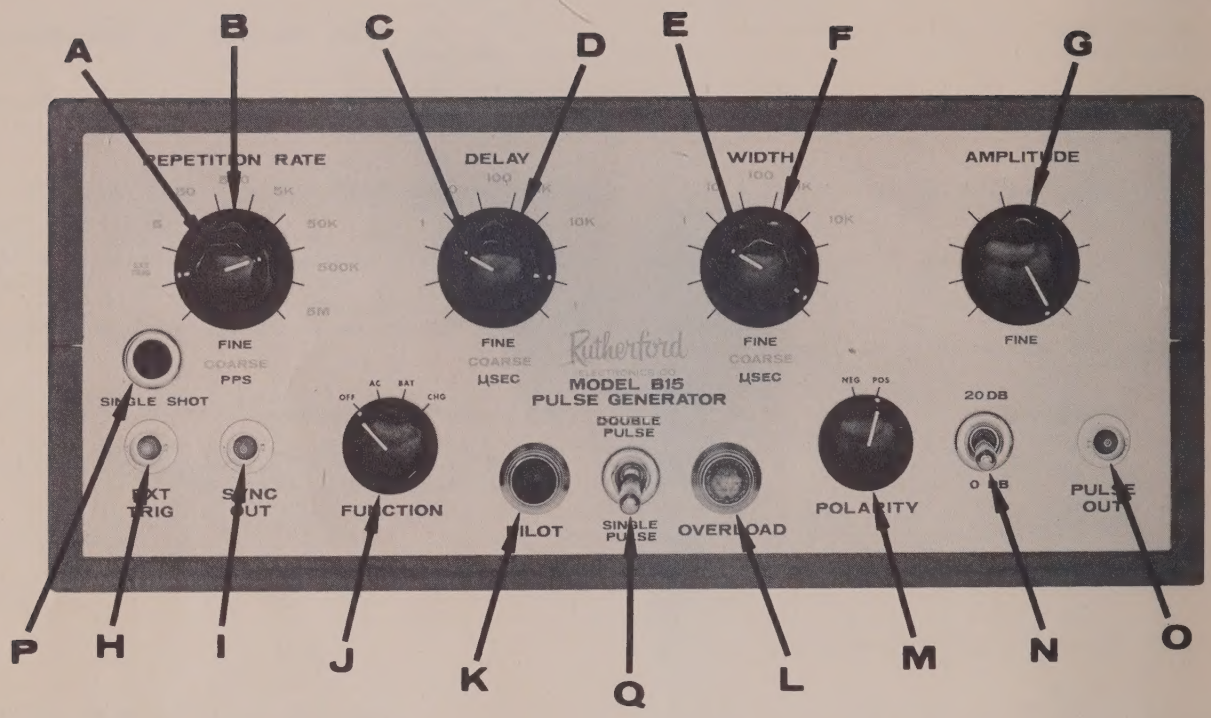



FIG. B: OPERATING CONTROLS

# OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS

Refer to Fig. B, above, for the location of the following front panel controls.

**A** REPETITION RATE RANGE SWITCH - Rotary switch, S1, selects "external trigger" operation or any range of internal oscillator operation.

**B** FINE REPETITION RATE CONTROL - Potentiometer, R4, is the vernier control of repetition rate through each of the internal oscillator ranges.

**C** DELAY RANGE SWITCH - Rotary switch, S3, selects any range of pulse delay.

**D** FINE DELAY CONTROL - Potentiometer, R16, is the vernier control of pulse delay through each delay range.

**E** WIDTH RANGE SWITCH - Rotary switch, S4, selects any range of pulse width.

**F** FINE WIDTH CONTROL - Potentiometer, R32, is the vernier control of pulse width through each width range.

**G** AMPLITUDE CONTROL - Potentiometer, R25, varies pulse amplitude from zero to full amplitude.

**H** EXT. TRIG. JACK - Coaxial connector, J1, couples a trigger pulse from an external source into the trigger amplifier, Q4, when operating in the "external trigger" mode.

**I** SYNC OUT - Coaxial connector, J2, couples out the unit synchronizing output pulse.

**J** FUNCTION SWITCH - Rotary switch, S2, selects the unit mode of power operation. It selects "off", "AC" when operating from standard 60 cycle line, "Bat" when operating from the internal battery pack, and "Chg" when re-charging the internal battery pack.

**K** PILOT LAMP - Lamp, DS1, indicates when the unit is on AC line operation only.

**L** OVERLOAD INDICATOR - Lamp, DS2, indicates when the unit is being operated in excess of 30% duty factor. It is a warning to the operator that the output pulse amplitude is being automatically reduced.

**M** POLARITY SWITCH - Rotary switch, S6, selects the polarity of the main output pulse.

**N** ATTENUATOR SWITCH - Toggle switch, S5, inserts a fixed 20db of attenuation. This should be used for improved pulse shape when operating at low output levels.

**O** PULSE OUT JACK - Coaxial connector, J3, couples out the main output pulse.

**P** SINGLE SHOT

**Q** PULSE MODE - Single or double pulse mode.

## PRELIMINARY INSTRUCTIONS

The 30% duty factor limitation is automatically controlled in the model B15. Should the duty factor limitation be exceeded, the model B15 automatically reduces the amplitude of the output pulse to such a level that the ratings of the output transistor are not exceeded. When the duty cycle limiter is in operation, the duty cycle lamp is lit to warn the operator of the reduced pulse amplitude condition.

## FIRST TIME OPERATION

The following procedure is recommended for putting the instrument into operation for the first time.

1. Turn the power (Function) switch to "OFF" and connect the line cord to a source of 115 volt, 50-60 cps power.

2. Set the instrument controls as follows:

| | | |
|---|---|---|
| A. | Repetition Rate Range | 50 kc |
| B. | Repitition Rate | 5 kc |
| C. | Delay Range | 1µsec |
| D. | Delay | 0µsec |
| E. | Width Range | 10µsec |
| F. | Width | 5µsec |
| G. | 20db Step Attenuator | 0db |
| H. | Amplitude | cw |
| I. | Polarity | "+" |
| J. | Pulse Mode | single pulse |

3. Connect an oscilloscope as follows:

| | | |
|---|---|---|
| A. | Sweep | 1µsec/cm |
| B. | Vertical Deflection | 5volts/cm |
| C. | Trigger | External from the sync out connector on the model B15 front panel. |

4. Connect a ground strap from the model B15 to a ground binding post on the oscilloscope.

5. Connect a resistive load between the pulse out connector and ground.

6. Connect the input probe of the oscilloscope across the external load. If the true waveform of the output pulse is to be observed, it is imperative that the oscilloscope input probe be properly compensated for viewing step function waveforms and that the probe ground strap be connected to the instrument chassis ground.

7. Turn the model B15 power switch to "AC" Adjust the trigger sensitivity of the oscilloscope for a stable trace. The model B15 controls may now be set to any desired values, taking into account duty factor considerations.

8. If the model B15 contains the optional battery pack, it may be switched to battery operation by turning the function switch to the "BAT" position.

# TECHNICAL DESCRIPTION

The following dissertation describes the technical operation of the model B15 and/or B15R pulse generator. It includes a technical description and the theory of operation of each of the circuits. A careful study of the block and timing diagram (Dwg # 0010001) and the schematic diagram (Dwg # 0010004) in conjunction with this discussion will aid in a thorough understanding of the generator.

For purposes of simplicity, all components are referred to by their schematic symbol number. The schematic diagram and/or the instruction manual parts list should be consulted to determine the value, tolerance, etc. of specific components.

## GENERAL DESCRIPTION

The model B15 consists of five sub-sections; the repetition rate section, the delay section, the width section, the output section, and the power supply.

The repetition rate section creates a basic system timing trigger. The repetition rate of the trigger is pre-determined by the setting of the front panel repetition rate range and vernier controls. This section also contains circuitry for triggering the generator from an external source and for supplying a $T_o$ synchronizing pulse.

The delay section accepts the trigger from the repetition rate section, delays it in time by an amount pre-determined by the front panel delay range and vernier settings, and presents a trigger to the width section. This trigger ultimately forms the leading edge of the output pulse.

The width section creates a waveform which starts in time coincidence with the output trigger of the delay unit and ends after a time which is pre-determined by the setting of the front panel width range and vernier dial.

The output section receives this waveform from the width section, amplifies it, and presents it as the main output pulse. The polarity and amplitude of the main output pulse are also determined by circuitry in the output section.

The power supply section furnishes all of the voltages necessary for the proper operation of the generator.

## THE REPETITION RATE SECTION

The repetition rate section consists of an emitter-coupled, free-running multivibrator (Q1 and Q3), a constant current source (Q2), a trigger amplifier (Q4), a sync pulse amplifier (Q5), and their associated circuitry.

For purposes of explanation, assume that the multivibrator is at the very beginning of a normal run-down period. Let us examine the conditions as they exist at this point in time.

1. There is a steady-state current flowing through R1, Q1, R4, and R3. This establishes a steady-state voltage at the base of Q3 which is a few volts negative with respect to the +7.5 volt supply. This also establishes a steady voltage at the base of Q2.

2. A small current is flowing through R6, Q3, and R7.

3. The selected timing capacitor (C2 through C7) is fully charged. The junction of CR1, CR2, and the timing capacitor is at a voltage which is positive with respect to the +7.5 volt supply.

Continuing on in time, the voltage at the junction of CR1, CR2, and the timing capacitor is decreasing linearly with respect to time due to the discharge of the timing capacitor by the constant current source Q2, and R5. At a certain point in time, the voltage at this junction reaches a level where CR1 starts to conduct. Let us stop at this point, just after the start of CR1 conduction, and again examine what is happening.

1. In starting to conduct, CR1 is drawing some of the current which had been flowing through Q1, R4, and R3. This decrease in current flow causes a drop in voltage at the base of Q3.

2. Current flow increases in Q3 which in turn increases the current flow through CR1, further cutting Q1 off. As Q1 is further cut off, the voltage at the base of Q3 drops further, etc.

This action, in a very short time, produces a surge of current through CR2, the timing capacitor, Q3, and R7. This surge recharges the capacitor to a point near its original charge, the final conduction of CR1 returns it to its full original charge, and the cycle begins again.

A positive-going pulse, created by the current surge during recharge time, is coupled from the collector of Q3, through C10, to the trigger amplifier, Q4. Note that in the external trigger mode of operation, the positive external trigger pulse is coupled directly into Q4 through C9. During this mode of operation, the timing capacitor is removed from the multivibrator by range switch S1, disabling the internal repetition rate section.

Decade ranges of repetition rate are established by the timing capacitors, C2 through C7 and C52, which are switched into the circuit by the range switch S1. Vernier control

of repetition rate through each range is accomplished by R4 which varies the constant current source used to discharge the timing capacitor. Potentiometer, R3, sets the low end calibration of all ranges by adjusting the steady-state voltage level at the base of Q2. High end calibration is accomlished by R5. By-pass and de-coupling components such as C1, C8-R63, and C16-R64 help to eliminate jitter and prevent interaction between the multivibrator and other circuitry within the unit.

The remaining circuit in the repetition rate section is the sync pulse amplifier, Q5. The negative-going timing pulse from the collector of Q4 is coupled into the base of Q5 through C12 and DL1. The positive-going sync pulse is coupled to the front panel jack, J2, through C14. Delay line, DL1, delays the synchronizing pulse by approximately 0.120 usec, with respect to the repetition rate section output trigger. This is approximately the time delay which is inherent in the remainder of the pulse handling circuitry. Thus, we are able to produce the output pulse with a minimum delay of 0.0 usec with respect to the sync pulse.

## THE DELAY SECTION

Transistors Q6, Q7, Q8, and Q9 form the delay section of the model B15. In the normal, steady-state condition Q8 is conducting, its base being held approximately one volt less positive than the base of Q7 by the CR8, CR9, and R23 combination. Q6 and Q7 are cut off, and Q9 is conducting.

When the negative-going trigger pulse from Q4 appears at the base of Q6 its collector goes momentarily positive, cutting off Q9. The emitter of Q9 goes a few volts positive and the current through R27 and R54 flows through the selected timing capacitor (C17 through C22). This flips the base of Q8 positive, which cuts Q8 off. Q7 picks up the current through R19, which in turn raises the voltage at the base of Q9 to an amount determined by the settings of R16 and R17.

The current through R27 and R54 continues to charge the timing capacitor and hold Q8 cut-off until the voltage at the junction of R27 and the timing capacitor reaches a value corresponding to the voltage set on the base of Q9. When this occurs, Q9 begins to conduct again, the base voltage of Q8 drops, allowing it to conduct again. Q7 cuts off and the circuit has returned to its normal steady-state condition. It will remain in this condition until the advent of another trigger pulse from the repetition rate section.

The trailing edge of the waveform at the collector of Q8 is differentiated and coupled through pulse transformer T2 to trigger the width section.

Thus, we have created a trigger pulse which is delayed in time with respect to the initiating trigger.

Decade ranges of delay are established by the timing capacitors, C17 through C22, which are switched into the circuit by range switch S3. Vernier control of delay through each range is accomplished by R16 which establishes the point in time that Q9 starts to conduct by setting the voltage level at the base of Q9. Potentiometer, R17, sets the low end calibration of all ranges by fixing a minimum voltage to which the base of Q9 may be set. High end calibration is accomplished by R27. By-pass and de-coupling components such as C41-R65, C43-R66, and C47-R57 help to eliminate jitter and prevent interaction between the delay circuit and other circuitry within the unit. Diode CR10 provides protection for the emitter-base junction of Q9.

## THE PULSE WIDTH SECTION

With the exception of the type of waveform coupled out, the width section operates in exactly the same manner as the delay section.

Transistors Q11, Q12, Q13, and Q14 form the pulse width section of the model B15. In the normal, steady-state condition Q13 is conducting, its base being held approximately one volt less positive than the base of Q12 by the CR13, CR14, and R38 combination. Q11 and Q12 are cut off, and Q14 is conducting.

When the negative-going trigger pulse from T2 appears at the base of Q11 its collector goes momentarily positive, cutting off Q14. The emitter of Q14 goes a few volts positive and the current through R39 and R55 flows through the selected timing capacitor (C28 through C33). This flips the base of Q13 positive, which cuts Q13 off. Q12 picks up the current through R34, which in turn raises the voltage at the base of Q14 to an amount determined by the settings of R32 and R33.

The current through R39 and R55 continues to charge the timing capacitor and hold Q13 cut off until the voltage at the junction of R39 and the timing capacitor reaches a value corresponding to the voltage set on the base of Q14. When this occurs, Q14 begins to conduct again, the base voltage of Q13 drops, allowing it to conduct again, Q12 cuts off and the circuit has returned to its normal steady-state condition. It will remain in this condition until the advent of another trigger pulse from the delay section.

The waveform at the collector of Q13, which is a negative-going pulse starting in time coincidence with the trigger from the delay unit and equal in duration to the desired pulse width, is coupled through R37 and C26 to the pulse forming section.

Decade ranges of width are established by the timing capacitors, C28 through C33, which are switched into the circuit by range switch S4. Vernier control of width through each range is accomplished by R32 which establishes the point in time that Q14 starts to conduct

by setting the voltage level of the base of Q14. Potentiometer, R33, sets the low end calibration of all ranges by fixing a minimum voltage to which the base of Q14 may be set. High end calibration is accomplished by R39. By-pass and de-coupling components such as C44-R67, C46-R68, and C48-R58 help to eliminate jitter and prevent interaction between the delay circuit and other circuitry within the unit. Diode CR15 provides protection for the emitter-base junction of Q14.

THE OUTPUT SECTION

The output circuit consists of Q15, Q16, Q17, Q18, and their associated circuitry. Q15, Q16, and Q17 are three stages of RC coupled amplifiers.

Q15 is normally conducting. The negative-going pulse width waveform drives it out of conduction, The positive pulse output of Q15 is shaped and amplified by Q16. The output of Q16 is coupled through a shaping network, R43-C35, to Q17. The positive output from Q17 is further shaped by R49, R60, and C36 and is coupled to Q18. For a positive output pulse, R50 is switched into the base drive circuit of Q18.

Depending on the position of polarity switch S6, the output transistor, Q18, is connected as an emitter-follower (positive output pulse) or as a normal inverting amplifier (negative output pulse).

The power supply for transistors Q16, Q17, and Q18 is variable from zero to approximately +20 volts. This is controlled by the output amplitude control, R25. The T-section attenuator pad (S5, R45, R46, and R47) is a 20db attenuator which provides improved pulse shape at very low output levels.

C35, C36, and C51 are pulse shape controls. Diodes CR16, CR17, CR18, CR20, and CR21 and resistor R53 are protective devices which serve the purpose of protecting the output section transistors from injury due to spikes kicked back from externally connected lines, etc. L1 is a peaking choke which sharpens the leading edge of the output pulse.

THE POWER SUPPLY SECTION

The power supply section supplies two zener (CR7) regulated voltages, +7.5 and +15 volts (referenced to internal ground) and a variable zero to +20 volt supply. These voltages are derived from a bridge rectifier (CR3, CR4, CR5, and CR6) on the secondary of the input power transformer, T1.

Potentiometer R25 adjusts the base drive to Q10 to control the variable voltage. Emitter-follower Q10 controls voltage over a wide range, giving pulse amplitude control from zero to full amplitude. Diode CR19 provides a bias for holding Q17 off.

The overload lamp, DS2, is an indication to the operator that the unit is operating in excess of 30% duty factor and that the output pulse amplitude is being reduced.

When the polarity switch is in the positive position, the internal ground of the generator is connected to chassis ground. In the negative position, the variable +20 volts is connected to chassis ground. Never physically connect the internal ground to chassis ground, as damage to the power supply will result.

# MAINTENANCE

The following suggestions are designed to aid the maintenance technician in scheduling regular preventative as well as corrective maintenance routines. It is important that maintenance routines be performed regularly in order to obtain maximum life and usefullness from the instrument.

Although the transistorized model B15 should give years of trouble-free operation, it is important that normal inspection and cleaning routines be observed.

At regular intervals, any dust which may have settled on the interior of the instrument should be removed by means of dry compressed air. Avoid the use of high velocity air streams which might injure delicate components or disturb adjustments. Persistent dirt may be removed with a lint-free cloth and, if necessary, carbon tetrachloride.

While cleaning the interior of the instrument, inspect the rotary switches for proper centering of the contacts in each index position. Improperly centered contacts may result if the switch has become warped or twisted. Avoid excessive pressure on these contacts, as they are easily damaged. If the silver plated contacts of the rotary switches have become tarnished due to non-use, they may be cleaned by rotating the switch through all of its positions several times.

## CALIBRATION

The model B15 contains nine (9) calibration controls and three (3) pulse shape adjustments, all of which are easily found when the covers are removed.

### REPETITION RATE

To calibrate repetition rate, set the rep rate range switch, S1, to the 50kc range. Set the fine rep rate control, R4, to the low end (ccw) vernier mark. Adjust R3 (LO REP RATE ADJ on the bottom of the circuit board) for a 5kc rep rate. Reset R4 to the high end (cw) vernier mark and adjust R5 (HI REP RATE ADJ on the bottom fo the circuit board) for a 50kc rep rate. Repeat this process several times as there is a certain amount of interaction between the two controls. Switch S1 to the 5mc range. Set R4 to the high end (cw) vernier mark. Adjust C2 (on the rep rate range switch) until the output pulse is operating at exactly 5mc (0.2µsec, pulse to pulse).

### DELAY

To calibrate delay, set the delay range switch, S3, to the 10µsec range. Set the fine delay control, R16, to the high end (cw) vernier mark and adjust R27 (HI DEL ADJ on the bottom of the circuit board) for 10µsec delay, referrenced to the sync pulse output. NOTE: The low delay adjustment, R17, is a very critical adjustment which is pre-set and sealed at the factory. It is strongly recommended that this adjustment not be readjusted in the field. Switch S3 to the 1µsec range. Set R16 to the high end (cw) vernier mark. Adjust C17 (on the delay range switch) until the leading edge of the output pulse is delayed by exactly 1µsec from the leading edge of the sync pulse output.

### WIDTH

To calibrate pulse width, set the width range switch, S4, to the 10µsec range. Set the fine width control, R32, to the high end (cw) vernier mark and adjust R39 (HI WID ADJ on the bottom of the circuit board) for 10 usecs pulse width, measured at 50% amplitude points. NOTE: The low width adjustment, R33, is a very critical adjustment which is pre-set and sealed at the factory. It is strongly recommended that this adjustment not be readjusted in the field. Switch S4 to the 1µsec range. Set R32 to the high end (cw) vernier mark. Adjust C28 (on the width range switch) until the pulse width is exactly 1µsec.

### PULSE SHAPE

C35 and C36 (on the top of the circuit board) and C51 (between S5 and S6) are pulse shape adjustments. It is recommended that a sampling oscilloscope be used in adjusting pulse shape, as the vertical amplifiers of a slower type oscilloscope degrade the pulse rise time to the extent that it is nearly impossible to make proper adjustments.

Open C51 to its minimum capacity. Set pulse width to minimum, polarity to "+", and amplitude to full output (cw). Adjust C35 for minimum output pulse width, being careful not to introduce undershoot. Switch to negative output. Adjust C36 for optimum pulse shape, being careful not to introduce undershoot. Repeat the adjustment of C35 and C36 several times as there is a certain amount of inter-action between the two controls. Finally, adjust C51 for fastest risetime, being careful not to introduce overshoot.

Introduce approximately 20db of attenuation with the amplitude control and recheck all parameters making slight readjustments if necessary.

## TROUBLE SHOOTING

The following trouble shooting suggestions are offered as being the most logical, step-by-step method of quickly ascertaining the reason for failure. This method assumes that there are no outputs from the generator in any mode of operation.

Step #1 — Check the input line voltage to ascertain that it is being delivered properly to the B15 input connector. If good, proceed to step #2.

Step #2 — Check all operating controls for proper setting. Specifically check that the delay or pulse width settings fo not exceed approximately 80% of the pulse to pulse spacing, that the amplitude control is in the clockwise position, that the attenuator toggle switch is in the 0db position, and that the function switch is in the AC position. If good, proceed to step #3.

Step #3 — Check the line fuse on the rear of the instrument. If blown, proceed to step #4. If good, replace and proceed to step #5.

Step #4 — Check for shorted T1, CR3 through CR6, or a voltage supply line shorted to internal or chassis ground.

Step #5 With the polarity switch in the "+" position, check the +15V., +7.5V., and variable 0 to +20 volt supply lines. In the "+" polarity position these may be checked against chassis ground. The 0 to +20 volt variable supply may be varied with the amplitude control. If voltages are in error, proceed to step #6. If they are good, proceed to step #7.

Step #6 If the +15 and +7.5V. supplies are bad, check the circuitry of zener diode CR7. If the variable supply is bad check the circuitry of emitter-follower, Q10.

Step #7 Check for a sync pulse out at J2. If it is not there, proceed to step #8. If it is present, proceed to step #9.

Step #8 Check for a negative-going pulse at the base of Q5. If it is there, replace Q5. If it is not there check for a positive pulse at the base of Q4. If it is there, replace Q4. If it is not there check the circuitry associated with the rep rate multivibrator; Q1, Q2, and Q3. Refer to the technical section of this manual for a complete description of the proper operation of this circuit.

Step #9 Sync the oscilloscope with the sync pulse and check for a positive-going pulse at the base of Q18. If it is present, check Q18 and the circuitry associated with S5 and S6. If it is not there, proceed to step #10.

Step #10 Check for a negative-going pulse at the base of Q17. If it is there, replace Q17. If it is not there, proceed to step #11.

Step #11 Check for a positive-going pulse at the base of Q16. If it is there, replace Q16. If not, proceed to step #12.

Step #12 Check for a negative-going pulse at the base of Q15. If it is there, replace Q15. If not, proceed to step #13.

Step #13 Check for a negative-going spike at the base of Q11. If it is present, check the circuitry of the width multivibrator; Q11, Q12, Q13 and Q14. Refer to the technical section of this manual for a complete description of the proper operation of this circuit. If there is no pulse at the base of Q11, proceed to step #14.

Step #14 Check for a negative-going spike at the base of Q6. If it is there, and it should be since there is a sync pulse, check the circuitry of the delay multivibrator; Q6, Q7, Q8, and Q9. Refer to the technical section of this manual for a complete description of the proper operation of this circuit.

# PARTS LIST

This parts list contains identifying information on all of the replaceable parts contained in the model B15 and/or B15R. These parts are listed in alpha-numerical order by schematic symbol number. All items with or without circuit reference numbers are considered replaceable parts.

The column headed "RUTHERFORD ELECTRONICS CO. STOCK #" is the component identifying number assigned by the RUTHERFORD ELECTRONICS CO.

The column headed "CIRCUIT REFERENCE #" designates the component as it is found on the schematic diagram, Dwg. # 0010004.

The column headed "DESCRIPTION" is, in general, a full electrical description of the component.

The column headed "SUGGESTED UNIT PRICE" gives only an indication of the probable cost for a single unit of the component or assembly listed, if purchased from the RUTHERFORD ELECTRONICS CO. It is not, in any case, to be construed as a firm price quotation. Any customer wishing to purchase a complete or partial set of spare parts should enter a request for quotation of price and delivery to the RUTHERFORD ELECTRONICS CO. or their authorized representatives.

The column headed "SUGGESTED SPARES" lists the quantity of each of the items which the manufacturer recommends as spares for one (1) years operation.

When ordering a complete or partial set of spares, specify by listing all of the information contained in this list for that particular part. The more descriptive information given on a parts order, the less chance there is for expensive and time consuming error.

Minimum parts order billing is $7.50. Prices are subject to change without notice.

## ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| cer | ceramic | k | kilohm or $10^3$ ohms | prec | precision |
| comp | composition | m | milli or $10^{-3}$ | PT | paper tubular |
| EMC | electrolytic, metal cased | meg | megohm or $10^6$ ohms | SM | silvered mica |
| EMT | electrolytic, metal tubular | MF | metal film | V | working volts, DC |
| f | farad | µ | micro or $10^{-6}$ | var | variable |
| GMV | guaranteed minimum value | µµ | micromicro or $10^{-12}$ | W | watt |
| h | henry | Ω | ohm | WW | wire wound |

## REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| B1 | 9001001 | BATTERY PACK | $ 75.00 | |
| C1 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV | .15 | 5 |
| C2 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V | .50 | 5 |
| C3 | 1528016 | CAPACITOR, fixed, SM, 100µµf, 500V, ±5% | .40 | 1 |
| C4 | 1528054 | CAPACITOR, fixed, SM, 4700µµf, 500V, ±1% | 1.22 | 3 |
| C5 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ±1% | 2.28 | 3 |
| C6 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ±1% | 2.25 | 3 |
| C7 | 1534016 | CAPACITOR, fixed, mylar, 4.7µf, 200V, ±1% | 9.20 | 3 |
| C8 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | 14 |
| C9 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV | .15 | |
| C10 | 1528018 | CAPACITOR, fixed, SM, 150µµf, 500V, ±5% | .48 | 1 |
| C11 | 1528015 | CAPACITOR, fixed, SM, 75µµf, 500V, ±5% | .40 | 1 |
| C12 | 1528012 | CAPACITOR, fixed, SM, 47µµf, 500V, ±5% | .40 | 1 |
| C13 | 1528020 | CAPACITOR, fixed, SM, 180µµf, 500V, ±5% | .48 | 2 |
| C14 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV | .15 | |
| C15 | 1520043 | CAPACITOR, fixed, EMC, 1500µf, 50V, -20+50% | 4.00 | 2 |
| C16 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C17 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V | .50 | |
| C18 | 1528028 | CAPACITOR, fixed, SM, 330µµf, 500V, ±5% | .60 | 3 |
| C19 | 1528054 | CAPACITOR, fixed, SM, 4700µµf, 500V, ±1% | 1.22 | |
| C20 | 1534004 | CAPACITOR, fixed, mylar, 0,047µf, 200V, ±1% | 2.28 | |
| C21 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ±1% | 2.25 | |
| C22 | 1534016 | CAPACITOR, fixed, mylar, 4.7µf, 200V, ±1% | 9.20 | |

# REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| C23 | 1520038 | CAPACITOR, fixed, EMT, 500µf, 25V, -10+50% | 2.30 | 2 |
| C24 | 1528020 | CAPACITOR, fixed, SM, 180µµf, 500V, ±5% | .48 | |
| C25 | 1520043 | CAPACITOR, fixed, EMC, 1500µf, 50V, -10+50% | 4.00 | |
| C26 | 1528028 | CAPACITOR, fixed, SM, 330µµf, 500V, ±5% | .60 | |
| C27 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C28 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V | .50 | |
| C29 | 1528028 | CAPACITOR, fixed, SM, 330µµf, 500V, ±5% | .60 | |
| C30 | 1528054 | CAPACITOR, fixed, SM, 4700µµf, 500V, ±1% | 1.22 | |
| C31 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ±1% | 2.28 | |
| C32 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ±1% | 2.25 | |
| C33 | 1534016 | CAPACITOR, fixed, mylar, 4.7µf, 200V, ±1% | 9.20 | |
| C34 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV | .15 | |
| C35 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V | .50 | |
| C36 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V | $ .50 | |
| C37 | 1520038 | CAPACITOR, fixed, EMT, 500µf, 25V, -10+50% | 2.30 | |
| C38 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C39 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C40 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C41 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C42 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C43 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C44 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C45 | 1520046 | CAPACITOR, fixed, EMT, 2000µf, 25V, -10+50% | 3.20 | 1 |
| C46 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C47 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C48 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C49 | | NOT ASSIGNED | | |
| C50 | 1518027 | CAPACITOR, fixed, cer, 0.1µf, 100V, -20+80% | .35 | |
| C51 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V, | .50 | |
| C52 | 1554007 | CAPACITOR, solid, tantalum, 68µf, 15V, ±10% | 2.50 | 1 |
| C53 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV | .15 | |
| | | | | |
| CR1 | 4800009 | DIODE, germanium, 1N116 | 1.50 | 6 |
| CR2 | 4800009 | DIODE, germanium, 1N116 | 1.50 | |
| CR3 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | 6 |

# REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| CR4 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | |
| CR5 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | |
| CR6 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | |
| CR7 | 4804008 | DIODE, zener, 1N1606 | 9.90 | 1 |
| CR8 | 4800009 | DIODE, germanium, 1N116 | 1.50 | |
| CR9 | 4800009 | DIODE, germanium, 1N116 | 1.50 | |
| CR10 | 4800020 | DIODE, germanium, 1N774 | .82 | 8 |
| CR11 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | |
| CR12 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR13 | 4800009 | DIODE, germanium, 1N116 | 1.50 | |
| CR14 | 4800009 | DIODE, germanium, 1N116 | 1.50 | |
| CR15 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR16 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR17 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR18 | 4800020 | DIODE, germanium, 1N774 | $ .82 | |
| CR19 | 4802015 | DIODE, silicon, 750ma, 100PIV, SC1 | 1.10 | |
| CR20 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR21 | 4800020 | DIODE, germanium, 1N774 | .82 | |
| CR22 | 4804021 | DIODE, zener, Z4XL6.2 | 1.34 | 1 |
| DL1 | 2354004 | DELAY LINE, fixed, 0.120usec | 8.50 | 1 |
| DS1 | 3912001 | LAMP, indicator, pilot (#47) | .15 | 1 |
| DS2 | 3912003 | LAMP, indicator, overload (#44) | .15 | 1 |
| F1 | 5180002 | FUSE, type 3AG, 0.5 amp | .18 | |
| J1 | 2128020 | CONNECTOR, coax, UG-657/U, type BNC | 1.88 | 1 |
| J2 | 2128020 | CONNECTOR, coax, UG-657/U, type BNC | 1.88 | |
| J3 | 2128020 | CONNECTOR, coax, UG-657/U, type BNC | 1.88 | |
| L1 | 1816005 | COIL, fixed, 0.24uH, ±15% | .60 | 1 |

# REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG. SPARES |
|---|---|---|---|---|
| P1 | 6025001 | CORD, power, w/plug, 3 wire | 1.12 | 1 |
| Q1 | 4830007 | TRANSISTOR, germanium, 2N1195 | 7.75 | 3 |
| Q2 | 4839001 | TRANSISTOR, silicon, 2N706 | 4.74 | 5 |
| Q3 | 4830007 | TRANSISTOR, germanium, 2N1195 | 7.75 | |
| Q4 | 4839001 | TRANSISTOR, silicon, 2N706 | 4.74 | |
| Q5* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | 9 |
| Q6* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q7* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q8* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q9* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q10‡ | 4835002 | TRANSISTOR, germanium, SYL1674 | 8.25 | 1 |
| Q11* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q12* | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q13* | 4838012 | TRANSISTOR, germanium, SM1475 | $ 4.75 | |
| Q14 | 4838012 | TRANSISTOR, germanium, SM1475 | 4.75 | |
| Q15 | 4839001 | TRANSISTOR, silicon, 2N706 | 4.74 | |
| Q16 | 4839001 | TRANSISTOR, silicon, 2N706 | 4.74 | |
| Q17 | 4830007 | TRANSISTOR, germanium, 2N1195 | 7.75 | |
| Q18 | 4839005 | TRANSISTOR, silicon, 2N2537 | 7.65 | 1 |
| * | 4838006 | 2N964 - can sub for SM1475 | | |
| ‡ | 4835001 | 2N1218 - can sub for SYL1674 | | |
| R1 | 4758681 | RESISTOR, fixed, comp, 680Ω, ½W, ±10% | .12 | 1 |
| R2 ⊛ | | RESISTOR, fixed, comp, 5[illegible], ½W, ±10% | .12 | |
| R3 | 4700014 | RESISTOR, var, comp, 500Ω, 1W, ±20% | 3.00 | 3 |
| R4 | 4700015 | RESISTOR, var, comp, 500Ω, 2W, ±20% | 3.75 | 3 |
| R5 | 4700008 | RESISTOR, var, comp, 1K, 1W, ±30% | 3.00 | 1 |
| R6 | 4758222 | RESISTOR, fixed, comp, 2.2K, ½W, ±10% | .12 | 2 |
| R7 | 4758271 | RESISTOR, fixed, comp, 270Ω ½W, ±10% | .12 | 2 |
| R8 | 4758152 | RESISTOR, fixed, comp, 1.5K, ½W, ±10% | .12 | 3 |
| R9 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | 9 |
| R10 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% | .12 | 5 |
| R11 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% | .12 | 5 |

⊛ Value assigned at time of calibration.

# REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| R12 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | |
| R13 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% | .12 | |
| R14 | 4758101 | RESISTOR, fixed, comp, 100Ω, ½W, ±10% | .12 | 3 |
| R15 | 4758181 | RESISTOR, fixed, comp, 180Ω, ½W, ±10% | .12 | 1 |
| R16 | 4700015 | RESISTOR, var, comp, 500Ω, 2W, ±20% | 3.75 | |
| R17 | 4700014 | RESISTOR, var, comp, 500Ω, 1W, ±20% | 3.00 | |
| R18 | 4760470 | RESISTOR, fixed, comp, 47Ω, 2W, ±10% | .24 | 1 |
| R19 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | |
| R20 | 4758561 | RESISTOR, fixed, comp, 560Ω, ½W, ±10% | .12 | 2 |
| R21 | 4760221 | RESISTOR, fixed, comp, 220Ω, 2W, ±10% | .24 | 1 |
| R22 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% | .12 | |
| R23 | 4758103 | RESISTOR, fixed, comp, 10K, ½W, ±10% | .12 | 2 |
| R24 | 4760390 | RESISTOR, fixed, comp, 39Ω, 2W, ±10% | .24 | 1 |
| R25 | 4700018 | RESISTOR, var, comp, 2.5K, 2W, ±20% | 4.04 | 1 |
| R26 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% | .12 | |
| R28 | 4758561 | RESISTOR, fixed, comp, 560Ω, ½W, ±10% | $ .12 | |
| R29 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% | .12 | |
| R30 | 4758101 | RESISTOR, fixed, comp, 100Ω, ½W, ±10% | .12 | |
| R31 | 4758101 | RESISTOR, fixed, comp, 100Ω, ½W, ±10% | .12 | |
| R32 | 4700015 | RESISTOR, var, comp, 500Ω, 2W, ±20% | 3.75 | |
| R33 | 4700014 | RESISTOR, var, comp, 500Ω, 1W, ±20% | 3.00 | |
| R34 | 4758102 | RESISTOR, fixed, comp, ~~1K~~, ½W, ±10% | .12 | |
| R35 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | |
| R36 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | |
| R37 | 4758122 | RESISTOR, fixed, comp, 1.2K, ½W, ±10% | .12 | 2 |
| R38 | 4758103 | RESISTOR, fixed, comp, ~~10~~K, ½W, ±10% | .12 | |
| R39 | 4700009 | RESISTOR, var, comp, 5K, 1W, ±30% | 3.00 | |
| R40 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% | .12 | |
| R41 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% | .12 | |
| R42 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% | .12 | |
| R43 | 4758152 | RESISTOR, fixed, comp, 1.5K, ½W, ±10% | .12 | |
| R44 | 4758122 | RESISTOR, fixed, comp, 1.2K, ½W, ±10% | .12 | |
| R45 | 4759390 | RESISTOR, fixed, comp, 39Ω, 1W, ±10% | .18 | 2 |
| R46 | 4758100 | RESISTOR, fixed, comp, 10Ω, ½W, ±10% | .12 | 7 |
| R47 | 4759390 | RESISTOR, fixed, comp, 39Ω, 1W, ±10% | .18 | |

# REFERENCE DESIGNATION INDEX

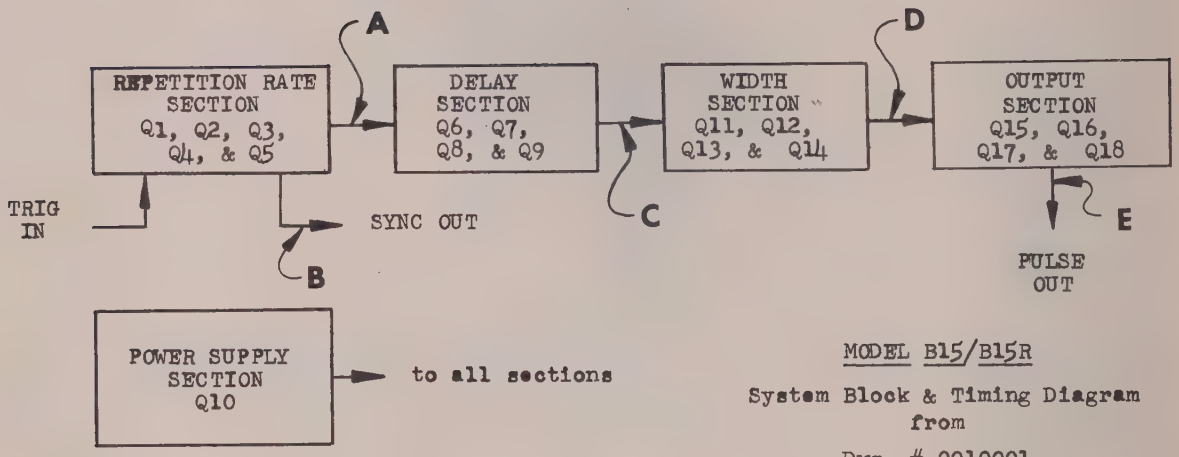
| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| R48 | 4758151 | RESISTOR, fixed, comp, 150Ω, ⅛W, ±10% | .12 | 1 |
| R49 | 4758222 | RESISTOR, fixed, comp, 2.2K, ⅛W, ±10% | .12 | |
| R50 | 4758330 | RESISTOR, fixed, comp, 33Ω, ⅛W, ±10% | .12 | 1 |
| R51 | 4758471 | RESISTOR, fixed, comp, 470Ω, ⅛W, ±10% | .12 | |
| R52 | 4758471 | RESISTOR, fixed, comp, 470Ω, ⅛W, ±10% | .12 | |
| R53 | 4760180 | RESISTOR, fixed, comp, 18Ω, 2W, ±10% | .24 | 1 |
| R54 | 4758102 | RESISTOR, fixed, comp, 1K, ⅛W, ±10% | .12 | |
| R55 | 4758102 | RESISTOR, fixed, comp, 1K, ⅛W, ±10% | .12 | |
| R56 | | | | |
| R57 | 4758220 | RESISTOR, fixed, comp, 22Ω, ⅛W, ±10% | .12 | 3 |
| R58 | 4758220 | RESISTOR, fixed, comp, 22Ω, ⅛W, ±10% | .12 | |
| R59 | 4758220 | RESISTOR, fixed, comp, 22Ω, ⅛W, ±10% | .12 | |
| R60 | 4758470 | RESISTOR, fixed, comp, 47Ω, ⅛W, ±10% | .12 | 3 |
| R61 | 4758470 | RESISTOR, fixed, comp, 47Ω, ⅛W, ±10% | .12 | |
| R62 | 4758470 | RESISTOR, fixed, comp, 47Ω, ⅛W, ±10% | .12 | |
| R63 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | .12 | |
| R64 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | .12 | |
| R65 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | $ .12 | |
| R66 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | .12 | |
| R67 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | .12 | |
| R68 | 4758100 | RESISTOR, fixed, comp, 10Ω, ⅛W, ±10% | .12 | |
| R69 | 4758271 | RESISTOR, fixed, comp, 270Ω, ⅛W, ±10% | .12 | |
| R70 | 4758152 | RESISTOR, fixed, comp, 1.5K, ⅛W, ±10% | .12 | |
| | | | | |
| S1 | 5110018 | SWITCH, rotary, rep rate range | 7.26 | 1 |
| S2 | 5110014 | SWITCH, rotary, function | 1.80 | 1 |
| S3 | 5110015 | SWITCH, rotary, delay or width range | 6.33 | 1 |
| S4 | 5110015 | SWITCH, rotary, delay or width range | 6.33 | |
| S5 | 5120005 | SWITCH, toggle, DPDT, 20DB attenuator | 1.80 | 1 |
| S6 | 5110016 | SWITCH, rotary, polarity | 2.67 | 1 |
| S7 | 5140001 | SWITCH, push-button, SPDT, single shot | 18.75 | 1 |
| S8 | 5120001 | SWITCH, toggle, SPST, single-double pulse | 1.80 | 1 |
| | | | | |
| T1 | 5640002 | TRANSFORMER, power | 12.50 | 1 |
| T2 | 5650004 | TRANSFORMER, pulse | 7.50 | 1 |

# REFERENCE DESIGNATION INDEX

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION | SUGGESTED UNIT PRICE | SUG-SPARES |
|---|---|---|---|---|
| | 2120001 | ADAPTER, power cord, 3 wire to 2 wire | .52 | 1 |
| | 8501008 | ASSY, switch, delay, w/comps assembled | 25.56 | |
| | 8501009 | ASSY, switch, polarity, w/comps assembled | 4.25 | |
| | 8501010 | ASSY, switch, rep rate, w/comps assembled | 30.11 | |
| | 8501008 | ASSY, switch, width, w/comps assembled | 25.56 | |
| | 1420001 | BRACKET, cord holding | 3.00 | |
| | 1410001 | COVERS, B15, top and bottom | 12.85 | |
| | 1410002 | COVERS, B15R, top and bottom | 14.75 | |
| | 2420001 | HANDLE, instrument | 2.75 | |
| | 2118003 | HOLDER, fuse | .62 | 1 |
| | 8700015 | HOLDER, lamp, clear | .64 | 1 |
| | 8700019 | HOLDER, lamp, green | .64 | 1 |
| | 2422018 | KNOB, instrument, amplitude | .60 | 1 |
| | 2422015 | KNOB, instrument, coarse rep rate, delay or width | .75 | 1 |
| | 2422016 | KNOB, instrument, fine rep rate, delay or width | .47 | 1 |
| | 2422017 | KNOB, instrument, function or polarity | .48 | 1 |
| | 9215003 | MANUAL, instruction | $ 5.00 | 1 |
| | 1445004 | PANEL, front, B15 w/silk screen | 9.75 | |
| | 1445005 | PANEL, front, B15R w/silk screen | 10.50 | |
| | 3130002 | STOOL, transistor insulator | .15 | 10 |

294 Ball Pen

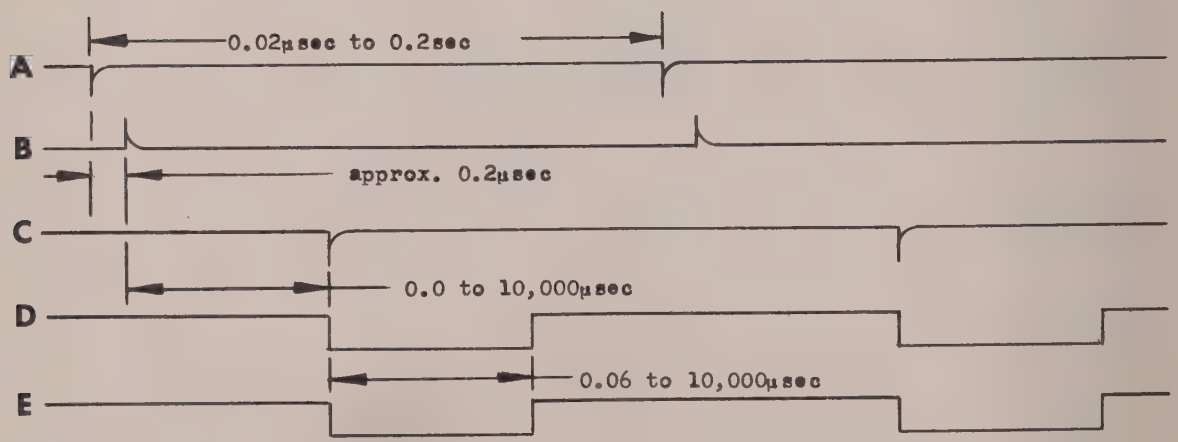
# BLOCK & TIMING DIAGRAM

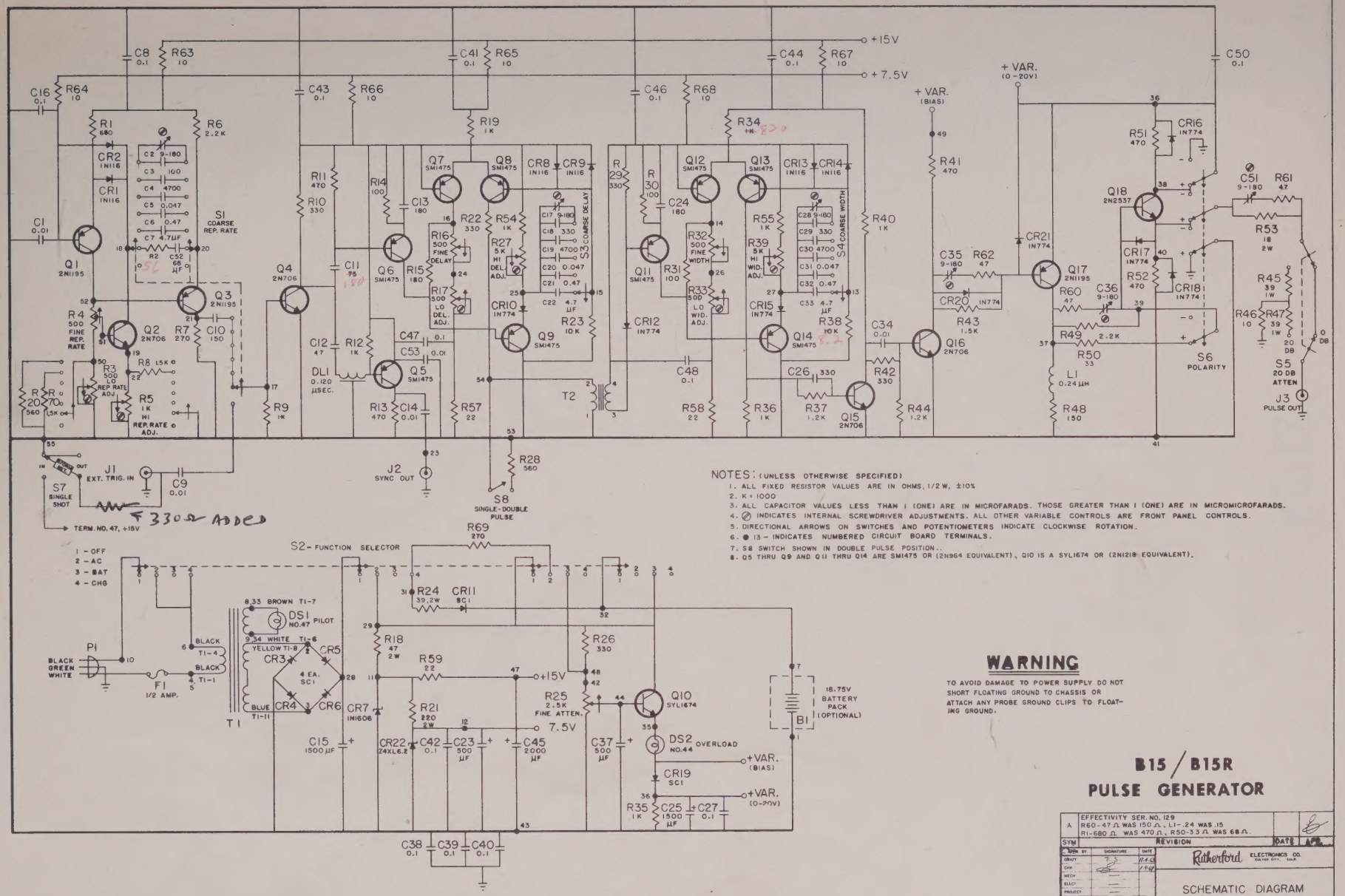



MODEL B15/B15R

System Block & Timing Diagram from

Dwg. # 0010001






NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL FIXED RESISTOR VALUES ARE IN OHMS, 1/2 W, ±10%
2. K = 1000
3. ALL CAPACITOR VALUES LESS THAN 1 (ONE) ARE IN MICROFARADS. THOSE GREATER THAN 1 (ONE) ARE IN MICROMICROFARADS.
4. ⊘ INDICATES INTERNAL SCREWDRIVER ADJUSTMENTS. ALL OTHER VARIABLE CONTROLS ARE FRONT PANEL CONTROLS.
5. DIRECTIONAL ARROWS ON SWITCHES AND POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
6. ● 13 - INDICATES NUMBERED CIRCUIT BOARD TERMINALS.
7. S8 SWITCH SHOWN IN DOUBLE PULSE POSITION..
8. Q5 THRU Q9 AND Q11 THRU Q14 ARE SMI475 OR (2N964 EQUIVALENT), Q10 IS A SYL1674 OR (2N1218 EQUIVALENT).

## WARNING

TO AVOID DAMAGE TO POWER SUPPLY DO NOT SHORT FLOATING GROUND TO CHASSIS OR ATTACH ANY PROBE GROUND CLIPS TO FLOATING GROUND.

# B15 / B15R
# PULSE GENERATOR

| SYM | REVISION | DATE | APP'D |
|---|---|---|---|
| A | EFFECTIVITY SER. NO. 129<br>R60-47Ω WAS 150Ω, L1-.24 WAS .15<br>R1-680Ω WAS 470Ω, R50-33Ω WAS 68Ω. | | |

| | NAME | SIGNATURE | DATE |
|---|---|---|---|
| DRAWN | T.S. | | 11-4-68 |
| CHK | | | 1-9-69 |
| MECH | | | |
| ELECT | | | |
| PROJECT | | | |
| APPROVED BY | | | |
| APPROVED BY | | | |

Rutherford ELECTRONICS CO. WALNUT CITY, CALIF.

SCHEMATIC DIAGRAM

CODE IDENT NO. 89248 | SIZE | DRAWING NUMBER 0010004

SCALE | REV | SHEET 1 OF 1

# NOTES

Rutherford ELECTRONICS CO.

10 000

x 40

400,000

Printed in U.S.A.

500/464